

Brachystoma angularis, Seeley; *Turbo Pictetianus*, D'Orb.; *Pleurotomaria regina*, Pict. & Roux; ? *P. Itieriana*, Pict. & Roux; *Pecten Raulinianus*, D'Orb.; *P. subacutus*, D'Orb.; and *Lima Rauliniana*, D'Orb. The author described as new species *Turrilites nobilis*, *Nautilus*, sp. nov., *Natica levistriata*, *Nerita nodulosa*, and *Lima interlineata*, and noted several corrections in the nomenclature adopted in his former list.

MISCELLANEOUS.

On the first Development of a Starfish. By M. H. FOUL.

IN a former note I endeavoured to show how the phenomena described by M. O. Hertwig in the sea-urchin may be compared to those which have been observed in other animals. Nevertheless the direct and continuous observation of these phenomena in some creature allied to the urchin could alone furnish a positive answer to these questions. With this object in view I made a fresh study at Messina, during the months of December and January last, of these earliest phenomena in *Asterias glacialis*.

The mature ovule possesses a large germinal vesicle and a very distinct germinal spot. The vitellus is granular, destitute of vitelline membrane, but enveloped in a mucilaginous layer, which is itself surrounded by a pavement epithelium. As soon as the ovule gets into the sea-water this epithelium is detached; the germinal vesicle then shrivels, the distinctness of its contours is lost, and in a manner it fuses in the vitellus. Its contents are never expelled, as was supposed by M. E. van Beneden. The germinal spot also loses its distinct outline, becomes paler, often changes its form, gradually diminishes, and finally dissolves. All that can now be seen in the vitellus are two light spots, one of which, very ill-defined, still occupies the place where the germinal vesicle was, while the other, which is of an ovoid form, approaches the surface. The use of reagents reveals at this moment the presence of a double protoplasmic star; and I shall in future give to these united double stars the name of *amphiaster*.

This first *amphiaster* often presents in its neutral plane bodies of irregular form, which I have reason to regard as relics of the membrane of the germinal vesicle. The last remains of the germinal spot are still visible at a certain distance from this *amphiaster*; but I shall not venture to assert that no fragment of the germinal spot can enter into the composition of the *amphiaster*. I incline to think that this first stellate figure is still not the one that gives origin to the polar corpuscles, but that, on the contrary, it divides in the interior of the vitellus, and that its peripheral aster alone gives origin to the *amphiaster* which will be expelled. However this may be, the vitellus soon presents only a superficial spot, which produces

the two polar corpuscles in the manner so well described by M. C. Robin. The use of picric acid shows the presence of an amphiaster which divides in such a manner that the peripheral aster becomes the first polar corpuscle; then the interior aster changes into a new amphiaster, the peripheral half of which constitutes the second polar corpuscle, whilst its interior half is converted into a little spot. This spot increases rapidly, at the same time advancing towards the centre of the vitellus, and changes into a true pronucleus furnished with one or two nucleoli. This female pronucleus stops before attaining the centre of the ovule, which now enters upon a new period of inactivity.

All the modifications that the vitellus has hitherto undergone have been occasioned by the mere contact of sea-water without any fecundation. They occur in exactly the same manner whether the ovum is fecundated or not. This fact is not new; but it needed to be confirmed by repeated experiments.

The ovule thus modified by a stay in sea-water is in the state best fitted to receive fecundation. If it is not fecundated it will remain unchanged for some hours, and then begin to decompose slowly. I have never seen it develop by parthenogenesis. Leaving out of consideration for the moment the abnormal cases which occur when the ovum is fecundated before or after the favourable moment, and when it is altered in any manner, we may pass in review the phenomena of normal fecundation.

The spermatozoids, on coming into contact with the ovum, remain with their bodies stuck into the mucous envelope. Soon one of them succeeds in making its way through half the thickness of this layer; and immediately the vitellus presents some extremely remarkable modifications. Before any contact has taken place between the spermatozoid and the vitellus, the protoplasm of the latter accumulates on the side which looks towards the nearest spermatozoid, and then forms a thin hyaline layer which coats the granular vitellus; then this transparent layer rises in its centre into a boss, which advances to meet the male element. The boss changes into a cone; and we soon see a delicate thread of protoplasm establishing communication between the apex of the cone and the body of the spermatozoid. The latter elongates, and, so to speak, flows into the vitellus. The tail, or, we may rather say, the vibratile cilium, alone remains outside, where it may be still distinguished for several minutes.

During this time the superficial hyaline layer gains more and more in extent, and finally envelops the whole vitellus. At the moment when the communication with the spermatozoid is established, this layer becomes very distinctly differentiated, and begins to detach itself from the surface of the vitellus to form a vitelline membrane. The differentiation of this membrane gains the whole circumference of the vitellus, commencing from the point of fecundation, where there remains a sort of little crater. In a perfectly mature and very fresh ovum all these phenomena succeed one another with such rapidity that access to the vitellus is barred to all

spermatozoids which are only a few seconds later than the first one. The penetration takes place at any point of the surface of the vitellus. I am of opinion that the normal fecundation of the starfish is effected by means of a single spermatozoid to each ovum; in the sea-urchin this fact is perfectly evident.

The point of penetration becomes the centre of a male star or aster; in the middle of the aster there is formed an aggregation or male pronucleus, which amalgamates with the female pronucleus exactly in the same manner as is observed in the sea-urchin. I need not, therefore, refer to it particularly.

From what precedes it results that the disappearance of the germinal vesicle and spot and the expulsion of the rejected materials are mere phenomena of the maturation of the ovule, and that the female pronucleus has no genetic connexion with the nucleolus of the ovule, and, lastly, that the spermatozoid exerts upon the vitelline material not only an attraction of contact, but even an attraction at a distance.—*Comptes Rendus*, Feb. 19, 1877, p. 357.

On the Fecundation of the Egg in the Echinus.

By M. J. PEREZ.

Every new fact relating to the fecundation of the egg being of considerable importance, it is essential not to regard it as definitively acquired in science until it has been subjected to careful checking. It is for this reason that I think it my duty to make known the observations that I have made upon the egg of *Echinus esculentus*, with the purpose of verifying the remarkable facts announced by M. H. Fol, in a note published in the 'Comptes Rendus' of the 19th February last.

I have twice had the opportunity of observing, at a point of the surface of the ovum, the projection described by M. Fol, and which that naturalist regards as raised by an *attraction at a distance* exerted by the spermatozoid nearest the vitelline sphere; but I found it impossible to ascribe to it the least importance in the act of impregnation. In fact, in one of the cases observed by me, no spermatozoid was at any moment opposite to this eminence up to the time of its disappearance by the rising of the vitelline membrane. In the second case a spermatozoid immersed in the mucous layer nearly at the middle of its thickness, after remaining motionless for a few seconds, moved briskly down to the apex of the projection. I saw no delicate prolongation of the latter emitted towards the spermatozoid; nor (and this is still more important) did I see the spermatozoid *flow*, according to M. Fol's expression, into the vitellus. It remained motionless, applied to the surface. Scarcely was it fixed there when another spermatozoid, following the same road as the first one, passed through the thickness of the mucous zone in two or three bounds, and also laid itself upon the surface of the little elevation. Two more spermatozoids took the same course, but stopped